

## Warm-Up 6

# What Is an Aquifer?



<b>Duration</b>	1 class period
<b>Grade Level</b>	7-9
<b>Key Terms Concepts/</b>	Aquifer Groundwater Porosity Saturated zone Saturation Water table
<b>Suggested Subjects</b>	Earth Science Physical Science

## Purpose

This lesson demonstrates the meaning of the terms groundwater, porosity, aquifer, and water table\*. It helps students better understand how and why water is stored underground, and what can happen if the water is drained or polluted. Students discuss the uses of groundwater in their community. They create an aquifer model and view the saturated and unsaturated zones. They also create a lake in the aquifer model and observe the connection between surface water and groundwater.

## Background

Many hazardous waste sites contaminate **groundwater**, which is a major source of drinking water in the United States. Many hazardous waste accidents and sites involve hazardous substances leaking into **aquifers** and contaminating groundwater.

Cleaning up groundwater is one of the major concerns the U.S. Environmental Protection Agency (EPA) and state environmental programs have about hazardous waste sites. This warm-up exercise provides some fundamental information for understanding groundwater. It also helps prepare students for *Activity 2: Examining a Hazardous Waste Site* where a hypothetical hazardous waste site is reviewed and students build a groundwater model.

For more information on groundwater and related topics, see the Suggested Reading list found at the end of the Haz-Ed materials.

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\* Adapted from Water Resources Professional's Outreach Notebook: Groundwater, by Stephen J. Vandas, U.S. Geological Survey, U.S. Department of Interior. For the complete Notebook, write: U.S. Geological Survey, Earth Science Information Center, Open-file Reports Section, Box 25286, MS-517, Denver Federal Center, Denver, CO 80225.



## Preparation

1. Gather the following materials:
  - 9-oz. ( 266-mL) clear plastic cup (1 per group)
  - resealable plastic sandwich bag filled with 3/4 cup of pea-size gravel (1 per group)
  - 3.4-oz (100-mL) graduated cylinder (1 per group)
  - 1 small bottle of blue food coloring
  - grease pencil (1 per group)
  - 1 gallon (3.8 liters) of water
  - 3 large sponges for cleanup
  - copies for each student of *Fact Flash 5: Groundwater*
2. Read *Fact Flash 5: Groundwater* to prepare your lecture for the class.
3. Assign students to read *Fact Flash 5: Groundwater* for homework.
4. Find out the source (surface, groundwater, or a combination) of the community's drinking water supply and uses of groundwater in the community. If available, find out the depth to groundwater, the type of aquifer, aquifer thickness, areal extent of the aquifer, and **porosity** of the aquifer that makes up the groundwater system beneath the community. For this information, contact the local office of the U.S. Geological Survey.
5. Fill the resealable plastic sandwich bags (1 for each group) with enough pea-size gravel to fill the model cups approximately 3/4 full.

## Procedure

1. Review Fact Flash 5 which students read as homework.
2. Ask the students if they know where the water in their community comes from. Approximately 50 percent of the nation's population receives its water from groundwater (the remainder uses surface water). Discuss uses of groundwater in the community. Inform the students of the depth to groundwater beneath their community and ask if they know what an aquifer is. If appropriate, ask how many of the students have wells at their homes. Have a student who has a well describe it.



3. Break the class into small groups and explain that each group is going to build a model of an aquifer. An aquifer is an underground rock formation composed of sand, soil, gravel, or porous rock that can store and supply groundwater to wells and springs. Generally, an aquifer provides groundwater that can be used as drinking water, or for irrigation or industrial purposes. Discuss the origin of their community's water supply. Designate one person in each group as a supply person. *(NOTE: This activity has been developed for small groups of students. Limit the number in each group to no more than 8. If this activity is to be conducted with more than one class, replace the wet materials with dry materials for each group.)*
4. Have the supply person from each group obtain 1 plastic cup, 1 resealable plastic sandwich bag containing pea-size gravel, and 1 graduated cylinder from the supplies you prepared. Have students pour the contents of the resealable plastic sandwich bag into the cup.
5. Ask students what they think will happen if they pour 30 mL of water into their group's aquifer cup model. Record responses on the chalkboard.
6. Have students pour 30 mL of water into their group's aquifer cup model and observe what happens. Compare the actual results to what the students guessed. Were they right? What were the differences? Have students pour an additional 30 mL of water into their aquifer. Inform the students that they have created an aquifer. *(NOTE: This aquifer is generic and is not intended to represent the local aquifer system.)*
7. Discuss the concept of **saturation**. Identify the **saturated zone** and the unsaturated zones in the aquifer cup model. Help students discover that the aquifer becomes saturated from the bottom of the aquifer cup model upwards.
8. Point out that the top of the saturated zone in an aquifer is the **water table**.
9. Instruct students to continue to add water until the water table is approximately a 1/2 inch (1.5 cm) below the top of the gravel. Mark the water table with the grease pencil on the outside of the cup.
10. Ask students to predict what will happen if they dig a hole in the gravel below the water table. Record responses on the chalkboard.
11. Have students dig a hole in their aquifer cup model and observe the results. Ask students what they have demonstrated. Were their prediction correct? *(Answer: a lake or a pond.)* Have students work together to determine how to make the water table higher or lower. *(Add more water or draw water out.)*



12. Discuss with the students the uses of groundwater in their area. Brainstorm ways groundwater might be polluted in the area. Have the students add 1 drop of blue food coloring to the lake of their model aquifer. Underscore the difficulty of cleaning up pollution by having the students try to flush their models of pollution by adding small amounts of water to their aquifer until the model almost overflows. Have the students pour water from their model aquifer into another container until the water level matches the mark they placed on the cup. Ask the students to look into their model aquifer to see if there is any colored water left in the aquifer.

## Extension (Optional)

- Invite someone from your state or local department of environmental management or your Regional EPA Superfund Office to discuss groundwater and its contamination. (See your local telephone directory and the *This Is Superfund* brochure at the back of this package for contact information.)